Islanded grid operation and restoration in electricity distribution networks following large-scale natural hazards

Nirmal Nair, Duncan Maina, Samad Shirzadi, Rodger Griffiths , Cosmin Cosma

National Science Challenges — Resilience to Nature's Challenges — Kia manawaroa – Ngā Ākina o Te Ao Tūroa

The University of Auckland New Zealand · Westpower · QuakeCoRE NZ Centre for Earthquake Resilience

Method

Depending on the various Simulated earthquake trajectories, different islanded grid scenarios are probable. The islands can be as a result of generators riding through the disaster event thus not shutting down, continuing to supply power to local loads without interruption. The islands can also be as a result of generators shutting down, then re-energizing the distribution network to feed the local loads.

Conventional Power system recovery

Generator Black Start → Transmission Reconfiguration → Load Restoration

Microgrid assisted Power system recovery

Down to Distribution

Transmission Level Restoration Process | Micro-grid Self healing and Restoration Process

Up to Transmission

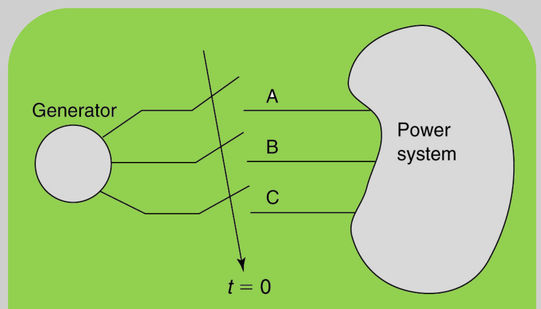
Resilience

the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Also includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

Challenges 1, 2, 3, 4

4 Reconnection

Re-connection of the formed islands to each other and to the grid requires proper strategy to avoid system re-collapse.



Reconnection

3 Control & Protection

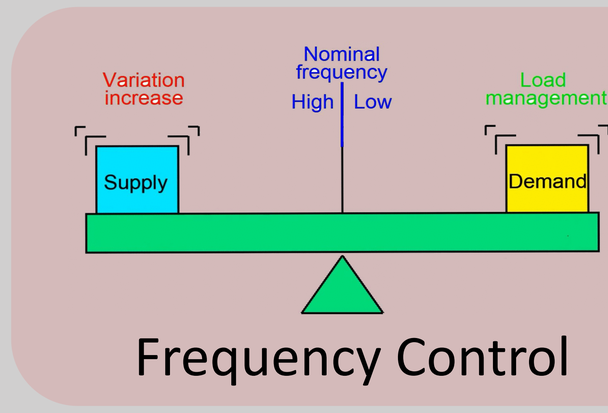
Different voltage / frequency control strategies and protection schemes are required for different islanding scenarios.

West Coast Project

This project assumes the occurrence of the AF8 earthquake splitting the Westcoast network into multiple segments. If the segments have available DGs (and connection to grid is unavailable due to the damage), then they can supply power to the vicinity loads while waiting for the repairs to be undertaken. The aim of this project is to investigate the islanding and restoration capability of the Westcoast network operated by Westpower.

2 Generator Stability

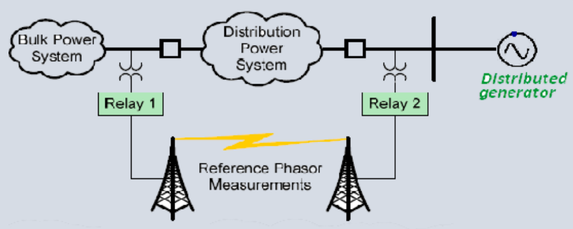
Rotor angle stability of the generators in the low inertia islanded grids is a challenge specially in a network designed to operate in grid connected mode.



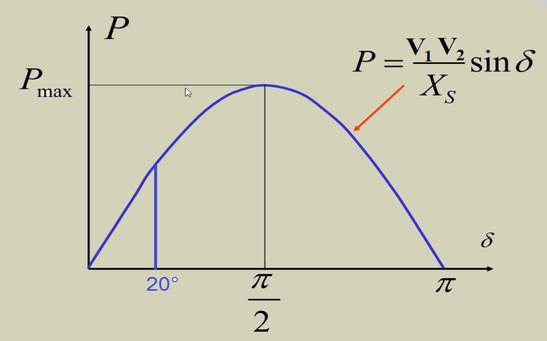
Frequency Control

1 Islanding Detection

Islanding detection is possible through either local or remote methods. Remote methods rely on communication. PMU-based techniques as communication-based techniques are getting more attractive by redeeming their deployment costs for their good technical performance



PMU



Angle Stability

Contact: sshi428@aucklanduni.ac.nz (Samad Shirzadi), dmai810@aucklanduni.ac.nz (Duncan Maina), n.nair@auckland.ac.nz (Nirmal Nair)/University of Auckland